


Optimum Nutrient Rate and Nutritional Constraints in Tuber Crops Growing Acid Ultisol

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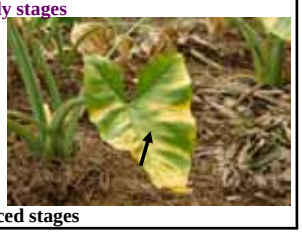
Interveinal chlorosis of older leaves


Early stages

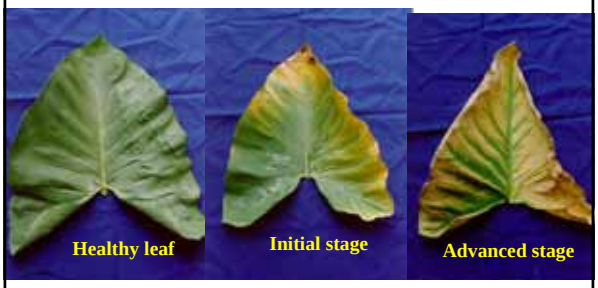



Advanced stages




Different stages of symptom manifestation

Complete crop failure due to the nutrient disorder



Different stages of disorder manifestation in leaf

Healthy tannia crop (5th month) in a field experiment at CTCRI during 2006

Critical Nutrient concentration of nutrients in the index leaf tissues of tropical tuber crops

Crops	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
	%					µg g^{-1}			
Cassava	5.45	0.43	1.65	0.80	0.30	130	85	8	45
S.Potato	4.00	0.22	2.60	0.76	0.12	33	19	4.50	11
Yams	1.88	0.18	1.92	0.25	0.55	493	86	526	22
Taro	3.67	0.36	2.43	0.75	0.52	56	675	17	48
Tannia	3.20	0.50	2.30	0.90	1.30	-	-	-	-
EFY	4.05	0.55	3.82	0.33	0.65	689	238	14	121

Mg content in the soil where deficiency was seen - 6.16 mg 100 g^{-1} (137.984 kg ha^{-1}),Leaf Mg content – 0.15-0.17%

Objectives

To standardize the optimum rate of application of nutrients including secondary and micronutrients for both upland and lowland soils

To identify the limiting/marginal critical nutrients in lowland and upland soils

To formulate a fertilizer management schedule for aroids especially *Xanthosoma*

Methodology

Experiments designed

- Preliminary rate experiment (Asher and Grundon, 1991)
- Nutrient omission pot experiment (Asher and Grundon, 1991)
- Observational trial on *Xanthosoma*
- Field experiment (Nutrient rate experiment with tannia)

Experiment 1

Preliminary rate experiment

Internationally defined and accepted experiment (Asher and Grundon, 1991)

Objectives

To optimize the basal application of nutrients
To identify the limiting or marginal nutrients in a particular soil

Year of conduct - 2005
Crop grown – Maize (DMRF-32)

Design: CRD
Replications : 3

Treatments : 6

1. 0 ALL
2. 0.5 ALL
3. ALL
4. 2 ALL
5. 3 ALL
6. 4 ALL

ALL - N, P, K, Ca, Mg, S, B, Zn, Mo,Fe, Mn, Cu, Co, Ni - General
N, P, K, Ca, Mg, S, B, Zn, Mo – Laterite soil

Composition of ALL treatment

Nutrients	N	P	K	Ca	Mg	S	B	Zn	Mo
Rate (kg ha^{-1})	100	30	80	35	30	25	2	4	0.4

Observation - Biomass yield of maize after harvest (at tasselling stage)

Quantity of nutrients to be added for 15 cm diameter pot (for ALL treatment)

Nutrient	Rate (kg ha^{-1})	Salt	Rate of application of salt (mg per 15cm pot)
N	100	NH_4NO_3	521
P	30	$NaH_2PO_4.2H_2O$	314
K	80	KCl	293
Ca	35	$CaCl_2$	179
Mg	30	$MgCl_2.6H_2O$	455
S	25	Na_2SO_4	202
B	2	H_3BO_3	20.7
Zn	4	$ZnCl_2$	15.1
Mo	0.4	$(NH_4)_6Mo_7O$	9.37

Experiment 2. Nutrient omission pot experiment

(Asher and Grundon, 1991)

Year of conduct - 2005

Design: CRD

Treatments: 10

Replications :3

1. ALL treatment	**6. ALL - Mg**
2. ALL –N	**7. ALL - S**
3. ALL - P	**8. ALL - B**
4. ALL - K	**9. ALL - Zn**
5. ALL -Ca	**10. ALL -Mo**

Observations - Biomass yield of maize at harvest (at tasselling stage)

Experiment 3. Observational Trial on Tannia

Year of Conduct – 2005

Observations

a. **Growth characters**
b. **Yield and yield components**
c. **Preliminary evaluation of the nutrient status of the trial site**
d. **Nutrient deficiency symptoms, if any**

Experiment 4. Nutrient Rate Experiment with Tannia

Design: RBD Factorial

Treatments : 10

Replications : 3

Preliminary Rate Trial

Upland soil

Lowland soil

Crop Grown – Maize (DMRF -32)

Biomass yield of Maize (g dry weight/pot)

Treatments	Low land	Upland
0 ALL	14.117	10.303
0.5 ALL	25.407	16.553
ALL	18.640	15.140
2 ALL	30.040	26.430
3 ALL	12.600	31.997
4 LL	37.097	33.407
CD (0.05)	6.829	14.487

Nutrient requirement for upland and low land soils are different.

The upland soils requires **2 ALL** (N, P,K, Ca, Mg, S,B, Zn and Mo @ 200,60,160,70,60.50,4,8,0.8 kg ha^{-1}) respectively

Lowland requires **4 ALL** (N, P,K, Ca, Mg, S,B, Zn and Mo @ 200,60,160,70,60.50,4,8,0.8 kg ha^{-1} respectively

2. Nutrient omission pot experiment

- To identify the critical limiting/marginal nutrients in lowland an upland soils
- Crop Grown – Maize (DMRF -32)
  Treatments - 10
  Replication - 3
  Design - CRD

Treatments

1. Optimum
2. Optimum-N
3. Optimum-P
4. Optimum-K
5. Optimum-Ca
6. Optimum-Mg
7. Optimum-S
8. Optimum-B
9. Optimum-Zn
10. Optimum-Mo

N Deficiency symptom

Chlorosis starting from leaf tips in older leaves followed by necrosis and drying of the whole plant

P Deficiency symptom

Reddish or purplish discolouration of green leaves and stem of older leaves

K deficiency

Initial

Advanced

Necrosis of leaf tips and margins of older leaves

Ca deficiency

Young leaves distorted, small, cup shaped, crinkled and terminal bud deteriorate

S deficiency

Mottled yellow green young leaves with yellowish veins

Zn deficiency

The main vein or vascular bundle become silver white

Appearance of marked stripe along the middle of the leaf

Biomass yield of Maize (g dry weight/pot)

Treatments	Upland	Lowland
Optimum	5.697	8.832
Optimum-N	0.817	4.607
Optimum-P	1.543	2.083
Optimum-K	1.897	1.237
Optimum-Ca	1.720	6.357
Optimum- Mg	5.043	6.790
Optimum-S	5.227	4.697
Optimum –B	1.520	4.019
Optimum -Zn	2.703	10.077
Optimum -Mo	2.833	3.473
CD (0.05)	1.245	2.873

In the upland, N, P, K, Ca, B, Zn and Mo and in lowland, N,P,K,S,B and Mo are found as limiting nutrients

Initial Soil Analysis of Low land and Upland Soils

Soil Type	pH	O.C	N	P	K	Ca	Mg	Fe	Cu	Mn	Zn
		(%)	kg ha^{-1}					µg g^{-1}			
Low land	5.3	0.779	237.91	56.83	474.38	401.80	200.81	80.25	6.40	6.43	25.46
Upland	5.38	0.664	195.92	49.34	49.28	429.68	236.77	30.52	1.30	12.94	6.98
Kuttalam	7.68	1.78	482.31	135.39	257.60	4380.0	1028.3	-	-	-	-

3. Observational Trial on Tannia

Objective

To assess the growth and yield levels of tannia under different nutrient management conditions

Number of Treatments : 10

1. Absolute Control (Ash and FYM @ 1 kg /plant each)
2. POP for Colocasia (NPK @ 80: 50:100 + FYM @ 12.5 t ha^{-1})
3. Organics alone (FYM + Ash + Bone meal + Neem cake)
4. FYM + Ash +Bone meal+ Neem cake+ 1/4 NPK
5. FYM + Ash +Bone meal+ Neem cake+ 1/4 NPK + $MgSO_4$
6. FYM + Ash +Bone meal+ Neem cake+ 1/4 NPK + $MgSO_4$ + $ZnSO_4$
7. FYM + Ash +Bone meal+ Neem cake+ 1/4 NPK + $MgSO_4$ + $ZnSO_4$ +Borax
8. FYM + Ash +Bone meal+ Neem cake+ 1/4 NPK + Lime + $MgSO_4$
9. FYM + Ash +Bone meal+ Neem cake+ 1/4 NPK + $ZnSO_4$ +Borax
10. FYM + Ash +Bone meal+ Neem cake+ $MgSO_4$

Biometric characters of the plant at harvest

Treatments	No. of leaves	Petiole length (cm)	Length of leaf (cm)	Breadth of leaf (cm)
T1	15	89	43	41
T2	11	92	45	44
T3	6	94	46	45
T4	15	130	42	43
T5	16	101	41	38
T6	10	93	41	45
T7	12	85	38	39
T8	11	110	46	45
T9	15	90	43	43
T10	7	62	28	28

Effect of Treatments on Yield and Yield Components (per plant)

Treatments	No. of cormels	Cormel weight (kg)	Mother corm weight (kg)	Total tuber weight (kg)	Leaf dry weight (g)	Tuber dry weight (g)
T1	7	1.14	1.28	2.42	556	548
T2	7	1.21	1.56	2.77	418	733
T3	13	1.19	1.81	3.09	730	791
T4	10	1.45	1.88	3.33	642	864
T5	9	1.30	2.08	3.38	560	914
T6	6	0.80	0.69	1.49	471	370
T7	10	0.96	0.92	1.88	294	341
T8	9	1.65	1.67	3.32	596	942
T9	7	1.33	1.18	2.51	452	676
T10	6	0.58	0.36	0.94	113	245